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Abdominal Aortic Aneurysm Clinical Practice Guidelines: A Methodological Assessment using the AGREE II Instrument

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1 Abdominal Aortic Aneurysm Clinical Practice Guidelines: A 2 Methodological Assessment using the AGREE II Instrument

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Strengths and Limitations of this Study

- This study uses a widely used validated assessment tool to objectively assess the methodological quality of abdominal aortic aneurysm (AAA) clinical practice guidelines (CPGs).
- Good inter-reviewer reliability was maintained across the five assessors who independently assessed the AAA CPGs.
- A systematic approach was used to identify CPGs for inclusion in this review.
- However, limited number of CPGs were available for assessment.

Abstract

Background: Abdominal aortic aneurysm (AAA) clinical practice guidelines (CPGs) provide evidence-based information on patient management; however, methodological differences exist in the development of CPGs. This study examines the methodological quality of AAA CPGs using a validated assessment tool.

Methods: Medline and EMBASE databases were searched from 1946 to 30th September 2020. Full-text, English language, evidence-based AAA CPGs were included. Consensus-based CPGs, summaries of CPGs or CPGs which were only available upon purchase were excluded. Five reviewers assessed their quality using the Appraisal of Guidelines for Research and Evaluation II instrument. An overall guideline assessment scaled score of $\geq 80\%$ was considered as the threshold to recommend CPG use in clinical practice.

Results: Seven CPGs were identified. Scores showed good inter-reviewer reliability (ICC 0.846, 95% CI 0.606-0.967). On average, CPGs performed adequately with mean scaled scores of over 50% in all domains. However, between CPGs, significant methodological heterogeneity was observed in all domains. Four CPGs scored $\geq 80\%$ (European Society of Cardiology, the Society of Vascular Surgery, the European Society of Vascular Surgery, and the National Institute of Health and Care Excellence), supporting their use in clinical practice.

Conclusion: Four CPGs were considered of adequate methodological quality to recommend their use in clinical practice; nonetheless, these still showed areas for improvement, potentially through performing economic analysis and trial application of recommendations. A structured approach employing validated CPG creation tools should be used to improve rigour of AAA CPGs. Future work should also evaluate recommendation accuracy using validated appraisal tools.

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56 Introduction

57 The management of the AAA patient is complex and involves members of the
58 multidisciplinary team, including, but not limited to, vascular scientists/technologists,
59 specialist nurses, emergency physicians, interventional radiologists, and vascular surgeons.
60 Multiple management pathways exist, with a spectrum of diagnostic and treatment options
61 available. Therefore, in view of this complexity and to aid clinicians in their management of
62 AAA, multiple clinical practice guidelines (CPGs) have been created by national and
63 international organisations. These are developed employing different methodologies, leading
64 to heterogeneity stemming from evidence grading, recommendation level, topics covered,
65 and the professionals who have been involved in their creation. Clinicians, while not legally
66 obligated to use CPGs, will often do so in their practice. Methodological rigour is therefore
67 required to provide accurate recommendations for the best care of AAA patients.

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69 The quality of individual CPG methodology may be assessed using objective
70 instruments designed for such a purpose. One such instrument is the Appraisal of Guidelines
71 for Research and Evaluation II (AGREE II) tool¹. While other tools exist, the AGREE II
72 instrument has been the most extensively employed to assess CPG methodological quality
73 and has been applied in many other clinical areas, including orthopaedic surgery and other
74 subject matters in vascular surgery^{2,3}. In addition, the AGREE II instrument has the benefit of
75 acting as both a scoring system to evaluate CPG methodology as well as providing a
76 framework for CPG development. In depth assessment of the process of CPG guideline
77 development is performed using six domains: 1) Scope and Purpose, 2) Stakeholder
78 Involvement, 3) Rigour of Development, 4) Clarity of Presentation, 5) Applicability and 6)
79 Editorial Independence; importantly, it does not evaluate the scientific or clinical accuracy of
80 the recommendations.

81
82 This study aims to employ the AGREE II instrument to determine the methodological
83 quality of current AAA CPGs to fulfil two main objectives:

- 84 1) Identify AAA CPGs of high methodological quality that may be recommended for
85 use in clinical practice.

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3 86 2) Determine areas for improvement in future versions of current AAA CPGs or newly
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5 87 developed CPGs.
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4 88 **Materials and Methods**

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7 89 **Search Strategy**

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9 90 The Medline and EMBASE bibliographic databases were searched from 1946 to 30th
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11 91 September 2020 using the search algorithm outlined below:

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14 93 (((((practice guideline*) OR clinical practice guideline*) OR recommendation*))
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16 94 AND
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18 95 (((management) OR diagnosis) OR assessment) OR treatment))
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20 96 AND
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22 97 (((((abdominal aorta) OR abdominal aortic aneurysm*) OR aortic aneurysm*) OR aorto-iliac
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24 98 aneurysm*) OR AAA))

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27 100 The reference lists of identified CPGs were hand searched to identify further relevant
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29 101 guidelines. Two reviewers (M.T., S.S.) independently performed the article search and
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31 102 reviewed the full CPGs to ensure fulfilment of all inclusion criteria. Any conflict between the
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33 103 two reviewers was discussed in person, and any unresolved disagreements were referred to
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35 104 a third reviewer (S.O.).

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39 106 **Inclusion and Exclusion Criteria**

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41 107 Full text, English language CPGs including evidence-based recommendations on AAA
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43 108 diagnosis and management were included. CPGs based only upon expert consensus, CPG
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45 109 summaries, or CPGs which were only available by purchase were excluded.

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49 111 **AGREE II Assessment**

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51 112 Five reviewers (M.T., S.S., M.M., A.G., T.L.) independently assessed the included CPGs.
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53 113 For each quality statement in the six domains of the AGREE II instruments, CPGs were rated
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56 114 from 1 (lowest quality) to 7 (highest quality) (**Table 1**). Domain scores were added and scaled
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59 115 using a predefined equation to determine the scaled quality score for each domain. All
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assessment and scaling of scores were performed according to the user manual available from the AGREE Research Trust website⁴.

A two-way mixed model was used to calculate intraclass correlation coefficients (ICCs) as a measure of inter-reviewer reliability. An overall guideline assessment scaled score of $\geq 80\%$ was required to consider the guideline of adequate quality to recommend use in clinical practice, as previously done in published studies using the AGREE II instrument^{5,6}. All statistical analyses were performed using SPSS® Statistics V25 (IBM®, United States of America).

Patient and Public Involvement

No patients were involved in this study.

Results

Selected Guidelines

Seven CPGs were identified from the literature search⁷⁻¹³. CPGs were published between 2005 and 2020. Guideline development group members included general practitioners, nurses, emergency physicians, radiologists, cardiothoracic surgeons and vascular surgeons. The CPGs originated from the United States of America (n=3)⁷⁻⁹, with the remainder coming from Europe (n=3)¹⁰⁻¹² and Brazil (n=1)¹³. Further guideline characteristics are summarised in **Supplement 1**.

Quality Scores

Inter-reviewer reliability varied between domains, ranging from moderate (domains 1 and 6) to good (domains 2, 3, 4, 5, and overall quality) as determined using the ICCs calculated. The overall ICC of all scores showed excellent reliability (ICC 0.943, 95% confidence interval 0.915 to 0.964) (**Table 2**).

Raw and scaled quality scores are summarised in **Table 3**.

Individual Domain Performance

Domain 1

Domain 1 focuses on the intended goals of the guideline, including statements that cover the scope of the CPGs or the health questions and target populations considered in the development of the CPGs.

AAA CPGs on average performed well in this domain (mean score 72.2±12.8%) with all CPGs scoring over 50% in the scaled scores. CPGs that performed better in this domain laid out clear review questions, specific objectives, and defined precisely the patient population that the CPG was intended for. For example, the European Society for Vascular Society (ESVS) CPG suggested that their CPG not only apply to patients with AAAs, but also to those with iliac artery aneurysms. Additionally, this CPG defined that the recommendations would include patients with “juxtarenal AAA, isolated iliac aneurysms, mycotic and inflammatory aneurysms

and concomitant malignant disease"¹¹. Poorer performing CPGs had either unclear objectives such as "critically reviewing the indications and the surgical results in the treatment of several aortic diseases"¹³ or failed to address any of the statements in their publication.

Domain 2

Domain 2 evaluates whether the CPG was developed by relevant stakeholders, which is essential for multidisciplinary input. It also considers the various aspects of healthcare provision offered by different healthcare professionals and the perspectives of the intended users of the CPG.

While CPGs performed adequately, there was greatest heterogeneity in scores for this domain (mean score $54.5 \pm 23.5\%$). This was largely due to the variability in team members that may be involved in the management of AAAs. For example, the Society of Interventional Radiology (SIR) guideline scored poorly due to the sole involvement of radiologists in the CPG development process. While this CPG arguably was targeted at patients undergoing endovascular aneurysm repair (EVAR), other medical professionals are involved in patients' care pre- and post-EVAR⁸. In this aspect, the National Institute of Health and Care Excellence (NICE) CPG performed well, involving paramedics, GPs, vascular nurses, anaesthetists, radiologists, and vascular surgeons in their guideline committee¹². With reference to patient involvement in particular, the ESVS did especially well to involve AAA patients in focus groups and obtain feedback on a plain English summary of the recommendations.

Domain 3

Domain 3 contains eight statements which appraise the evidence-based rigour of the literature search methodology, evidence selection and evaluation, as well as the procedure followed in the formulation of recommendations, together with the processes in place to permit guideline updating.

CPGs had acceptable scores in this domain, averaging $65.2 \pm 18.4\%$. CPGs that performed poorly failed to describe the literature search methodology or the formulation of the methods involved in the development of their recommendations. The CPGs that performed well provided detailed information regarding a systematic evidence search (e.g.

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3 191 databases, inclusion/exclusion criteria), recommendation formulation methodology (e.g.
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5 192 Delphi consensus), and the avenues for feedback prior to CPG publication. For example, the
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7 193 NICE committee published a draft document which was freely available online, allowing any
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9 194 registered stakeholder to provide their comments on the draft recommendations¹². In
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11 195 addition to systematic reviews answering specific questions on the best modality and optimal
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13 196 frequency for surveillance after EVAR, the Society for Vascular Surgery (SVS) CPG also
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15 197 performed an “umbrella” systematic review to synthesise evidence from previous reviews.
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17 198 This CPG also clearly outlined the databases used in their evidence search and provided the
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19 199 full search strategy in the appendix.
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22 201 **Domain 4**
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24 202 Domain 4 evaluates the organisation of the guideline, discussing language and format.
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26 203 This domain includes statements assessing the ambiguity of included recommendations and
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28 204 the ease for CPG users to identify important recommendations.
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31 205
32 206 CPGs performed very well in this domain (mean score 81.0±20.1%), with four CPGs
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34 207 achieving a scaled score of >90%^{7,9-11}. These CPGs all provided clear summaries of their
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36 208 recommendations, highlighting important recommendations that should be implemented.
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38 209 Consistent formatting was used to draw readers’ attention to each recommendation, either
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40 210 with the recommendations placed in tables⁹⁻¹¹ or clear signposting of recommendations
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42 211 followed by the evidence related to them⁷. These CPGs also did well in placing their key
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44 212 recommendations in a summary section at the very start of the document^{9,12}.
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47 214 **Domain 5**
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49 215 Domain 5 assesses how guideline developers take into account the translation of
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51 216 recommendations into clinical practice. These statements include the consideration of
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53 217 barriers and facilitators to implementation, uptake improvement strategies and resources
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55 218 required for implementation.
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58 220 CPGs fared worst in this domain, with the lowest average scores recorded (mean score
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60 221 47.1±21.2%). One method to identify potential resource limitations would be to implement a
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223 222 pilot implementation – this strategy, unfortunately, was not used by any CPG development

group in this review. Alternatively, cost-effectiveness analysis could be very useful in estimating the economic impact of recommendation implementation. Cost-benefit analysis performed in other reviews were considered in the NICE and SVS CPGs^{9,12}. Furthermore, these CPGs also provided potential research and audit questions to improve the current evidence base and service provision^{9,12}.

Domain 6

Domain 6 includes statements defining competing interests, both at the individual (declaration of individual CPG development group members' conflicts of interest) and institutional level (funding bodies' involvement).

In this domain, CPGs performed adequately and achieved an average scaled score of $66.2 \pm 22.7\%$. CPGs that performed well provided unequivocal statements that described the conflicts of interest of CPG development group members^{7,12} and, if any, the involvement of funding agencies. One CPGs failed to include any statement of such a nature¹³, which is an easily corrected omission in future versions of this CPGs.

Overall Guideline Assessment

The Overall Guideline Assessment consists of two components: the overall quality rating of the CPG (rated from 1 to 7), and whether the reviewer would recommend use in clinical practice. Based on the predefined criteria of a scaled score of $>80\%$, four guidelines⁹⁻¹² were rated of adequate methodological quality for use in clinical practice. These guidelines were from the European Society of Cardiology¹⁰, the Society of Vascular Surgery⁹, the European Society of Vascular Surgery¹¹, and the National Institute of Health and Care Excellence¹².

Discussion

AAA-related mortality is considerable, ranked as the 12th to 15th cause of death in the United States of America (USA), United Kingdom (UK) and various European countries¹⁴. Mortality post-AAA rupture can exceed 80% and contributes to over 44.6 deaths per 100,000 population in the UK¹⁵. It is thus of utmost importance that CPGs detailing recommendations related to the diagnosis and management of this critical condition be of good quality, robust evidence base and easy access. Quality in CPGs stems from methodological rigour, and four CPGs included in this review were considered of adequate methodological quality for use in clinical practice.

While no clear characteristic significantly impacted on the AGREE II scores, a good domain 1 performance appeared to set a higher standard for other domain scores. This may be due to having clear methodology outlined prior to the beginning of the CPG development process – clear objectives, specific clinical questions, specific patient populations on whom to apply the recommendations – which may set a framework for meticulous methodology in other domains. However, with no clear statistical interdomain correlation of scores for each CPG, it is clear that methodological rigour in each domain is independent and therefore, independent efforts are essential to correct the issues identified. This may be assisted by the multiple guideline development frameworks that exist, including the AGREE II instrument, G-I-N Standards¹⁶, or Guidelines 2.0¹⁷. To reduce heterogeneity between CPGs, the international community should agree upon a specific framework for use in future CPG development.

It must be noted that in some CPGs a limited scope of individuals and specialties were involved in the creation of the guidelines. For example, as discussed in the results for domain 2 above, the Society of Interventional Radiology CPG only included interventional radiologists in their CPG development group; consequently, the document focused on specific AAA management options (namely the various types of endovascular repair)⁸. Inclusion of a more diverse panel in the CPG development group, on the other hand, resulted in broader and more holistic approaches to how AAAs should be managed. This is reflected in lower scores in domain 2 as well as the overall scores of the AGREE II instrument.

Domain 5 was the poorest performing domain in this assessment, with four achieving a scaled score of <50% (7,9,10,13). This is not an isolated issue pertaining to AAA CPGs – the lack of consideration of the resources required to apply CPG recommendations has been seen in other vascular surgery topics including venous leg ulcers³ and lymphoedema¹⁸, and other fields such as orthopaedics². Echoing the conclusions of these reviews, poor performance in this domain is especially concerning as recommendations on paper are futile if not translated into clinical practice and applicable to the target populations. This is additionally important in the management of AAA given the variable costs that arise depending on the modality of treatment (i.e. open versus endovascular repair) – a recent observational study from the USA showed that while EVAR was associated with lower admission and fixed costs when compared to open repair, this was outweighed by increases in variable hospitalisation costs associated with the procedure over time¹⁹. It is clear therefore that resource allocation must be considered in the formulation of CPG recommendations. Recommendations should reflect the economic situation of the local population and not be universal management ideals that may be unattainable in the specific country or region.

It is important to note that while this study does not intend to examine the accuracy of the recommendations nor the robustness of the evidence behind them, it would nonetheless be remiss of the authors not to discuss issues with the current evidence. Most of the recommendations are based on historic RCTs, including the UK EVAR-1²⁰ and EVAR-2²¹ amongst others²²⁻²⁴ – evidence-based recommendations will be limited by old data if trials were performed more than a decade ago. These trials need to be updated, especially considering the constantly evolving technologies increasingly employed in vascular surgery today, although recent registry data does seem to suggest that the findings of these trials currently hold true²⁵⁻²⁷. CPGs, as an extension, should therefore also be constantly updated as newer trials are published – certain groups have proposed using an online electronic wiki platform, allowing CPGs to become “living documents” that can be updated in sections²⁸ as new trial data becomes available.

The assessment of AAA guidelines via the AGREE II instrument has highlighted methodological inadequacies. Development groups of future versions of these CPGs should consider addressing these factors. Furthermore, while this review has provided a detailed

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313 methodological assessment of currently available AAA CPGs, readers should note that has not
314 addressed the scientific accuracy of the recommendations.
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For peer review only

316 Conclusion

317 In this methodological review of current AAA CPGs, four have been deemed adequate
318 for clinical use; nonetheless, all have been showed to have shortfalls in their methodology.
319 Future CPG iterations should consider that rigorous methodology can only be achieved
320 through conscious effort – high methodological quality in existing CPG versions may not
321 necessarily result in high quality future versions. A structured approach is integral to an
322 organised outcome – instruments to provide such a structure and thus boost methodological
323 rigour are widely available and should be implemented by developmental groups to improve
324 confidence in CPG rigour. This will, in turn, support the implementation of good evidence-
325 based recommendations to improve the care of AAA patients internationally.

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Author Contributions

M.T., S.O. and A.H.D. contributed to the conceptualisation of the review idea. M.T., S.S., M.M., A.G. and T.L. performed the methodological assessments of the guidelines. M.T. performed the statistical analysis and together with S.S. wrote the initial manuscript. S.O., T.L. and A.H.D. provided critical input into subsequent drafts of the manuscript. A.H.D. supervised the project. All authors provided critical feedback and contributed to the final version of the manuscript.

Ethical Approval

No ethical approval was required for this study as there was no involvement of patients or animals.

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Conflicts of Interest

All authors report no relevant conflicts of interests.

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Tables

Table 1: AGREE II instrument domains and statements

Domain	Statements
1 – Scope and Purpose	<div>1. The overall objective(s) of the guideline is (are) specifically described.</div> <div>2. The health question(s) covered by the guideline is (are) specifically described.</div> <div>3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.</div>
2 – Stakeholder Involvement	<div>4. The guideline development group includes individuals from all relevant professional groups.</div> <div>5. The views and preferences of the target population (patients, public, etc.) have been sought.</div> <div>6. The target users of the guideline are clearly defined.</div>
3 – Rigour of Development	<div>7. Systematic methods were used to search for evidence.</div> <div>8. The criteria for selecting the evidence are clearly described.</div> <div>9. The strengths and limitations of the body of evidence are clearly described.</div> <div>10. The methods for formulating the recommendations are clearly described.</div> <div>11. The health benefits, side effects, and risks have been considered in formulating the recommendations.</div> <div>12. There is an explicit link between the recommendations and the supporting evidence.</div> <div>13. The guideline has been externally reviewed by experts prior to its publication.</div> <div>14. A procedure for updating the guideline is provided.</div>
4 – Clarity of Presentation	<div>15. The recommendations are specific and unambiguous.</div> <div>16. The different options for management of the condition or health issue are clearly presented.</div> <div>17. Key recommendations are easily identifiable.</div>
5 – Applicability	<div>18. The guideline describes facilitators and barriers to its application.</div> <div>19. The guideline provides advice and/or tools on how the recommendations can be put into practice.</div> <div>20. The potential resource implications of applying the recommendations have been considered.</div> <div>21. The guideline presents monitoring and/or auditing criteria.</div>
6 – Editorial Independence	<div>22. The views of the funding body have not influenced the content of the guideline.</div> <div>23. Competing interests of guideline development group members have been recorded and addressed.</div>
Overall Assessment	<div>1. Rate the overall quality of this guideline.</div> <div>2. I would recommend this guideline for use. (Yes, Yes with modifications, No)</div>

Table 2: Intraclass correlation coefficient of scores given to the individual domains

Domain	Intraclass Correlation	95% Confidence Interval	
		Lower Bound	Upper Bound
1	0.679	0.364	0.921
2	0.891	0.722	0.977
3	0.797	0.541	0.954
4	0.753	0.469	0.943
5	0.875	0.688	0.973
6	0.709	0.405	0.930
Overall Quality	0.841	0.620	0.965
All Domains	0.943	0.915	0.964

Table 3: Individual reviewer, raw total, and scaled scores for individual domains. Cells with scaled scores $\leq 25\%$, 26-50%, 51-75%, and $\geq 76\%$ are coloured with red, orange, yellow, and green respectively. Bolded scaled scores reflect the lowest and highest scores in each domain.

Guideline	Domain (min. score, max. score)						
	1 (min. 3, max. 21)	2 (min. 3, max. 21)	3 (min. 8, max. 56)	4 (min. 3, max. 21)	5 (min. 4, max. 28)	6 (min. 2, max. 14)	Overall (min. 1, max. 7)
American College of Cardiology/American Heart Association (2005) (9)							
Reviewer 1	14	11	40	18	12	11	5
Reviewer 2	18	14	41	20	19	11	6
Reviewer 3	17	13	46	20	20	11	6
Reviewer 4	15	13	44	20	16	13	6
Reviewer 5	15	8	49	21	10	12	5
Raw total	79	59	220	99	77	58	28
Scaled (%)	71.1	48.9	75.0	93.3	47.5	80.0	76.7
Brazilian Society of Cardiovascular Surgery (2006) (15)							
Reviewer 1	11	8	20	13	5	2	3
Reviewer 2	14	9	34	20	9	2	4
Reviewer 3	14	10	30	18	9	2	4
Reviewer 4	12	7	16	12	4	5	2
Reviewer 5	14	8	16	12	4	11	4
Raw total	65	42	116	75	31	22	17
Scaled (%)	55.5	30.0	31.7	66.7	9.2	20.0	40.0
Society of Interventional Radiology (2010) (10)							
Reviewer 1	10	6	32	8	10	7	4
Reviewer 2	18	11	40	12	13	9	5
Reviewer 3	15	10	42	14	15	8	5
Reviewer 4	12	8	22	9	11	11	4
Reviewer 5	13	6	22	9	11	9	3
Raw total	68	41	158	52	60	44	21
Scaled (%)	58.9	28.9	49.2	41.1	33.3	56.7	53.3
European Society of Cardiology (2014) (12)							
Reviewer 1	15	10	40	17	15	12	6
Reviewer 2	21	15	43	21	22	12	6
Reviewer 3	19	14	46	19	22	12	6
Reviewer 4	12	9	34	21	9	12	5
Reviewer 5	15	10	34	21	9	12	6
Raw total	82	58	197	99	77	60	29
Scaled (%)	74.4	47.8	65.4	93.3	47.5	83.3	80.0
Society for Vascular Surgery (2017) (11)							
Reviewer 1	14	10	39	17	21	9	6
Reviewer 2	19	16	49	19	23	12	7
Reviewer 3	17	14	48	21	21	11	6
Reviewer 4	15	16	45	21	16	10	6
Reviewer 5	17	12	45	21	16	11	5
Raw total	82	68	226	99	97	53	30
Scaled (%)	74.4	58.9	77.5	93.3	64.2	71.7	83.3
European Society of Vascular Surgery (2019) (13)							
Reviewer 1	13	13	37	16	15	8	6
Reviewer 2	18	19	48	19	23	11	7
Reviewer 3	18	18	50	21	21	11	6

Reviewer 4	17	15	42	21	13	10	6
Reviewer 5	18	14	42	21	13	10	6
Raw total	84	79	219	98	85	50	31
Scaled (%)	76.7	71.1	74.6	92.2	54.2	66.7	86.7
National Institute of Clinical Excellence (2020) (14)							
Reviewer 1	18	18	44	19	21	12	7
Reviewer 2	19	20	50	17	25	13	7
Reviewer 3	21	21	51	17	27	13	7
Reviewer 4	21	21	47	20	18	11	7
Reviewer 5	21	21	47	20	18	12	7
Raw total	100	101	239	93	109	61	35
Scaled (%)	94.4	95.6	82.9	86.7	74.2	85.0	100.0
Average scaled scores							
Mean ± SD (%)	72.2 ± 12.8	54.4 ± 23.5	65.2 ± 18.4	81.0 ± 20.1	47.1 ± 21.2	66.2 ± 22.7	74.3 ± 20.6

Supplement 1: Guideline characteristics

Guideline (Year)	Author/Organisation	Healthcare Professionals Involved in Guideline Development	Evidence Grading System	Summary of Guideline Creation Procedure
	Country/Region		Recommendation Grading System	
ACC/AHA Practice Guidelines for the Management of Patients With Peripheral Arterial Disease (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic) (2005)	American College of Cardiology (ACC) /American Heart Association (AHA)	Vascular surgeons Interventional radiologists Vascular physicians Cardiologists Nurses	System developed and approved by ACC/AHA	The Committee to Develop Guidelines for Peripheral Arterial Disease conducted a literature search. Using evidence-based methodologies developed by the ACC/AHA Task Force on Practice Guidelines, the committee wrote the guideline text and recommendations. All guideline recommendations were formally voted on via a confidential ballot. The guidelines were then peer-reviewed and approved for publication by the governing bodies of the American College of Cardiology (ACC) and the AHA and endorsed by collaborating organizations.
	USA		System developed and approved by ACC/AHA	
Guidelines for Surgery of Aortic Diseases from Brazilian Society of Cardiovascular Surgery (2007)	Brazilian Society of Cardiovascular Surgery	Cardiovascular surgeons Cardiothoracic surgeons	System developed and approved by ACC/AHA	The authors met periodically to elaborate the text and review the relevant bibliographic citations provided by the official committee members designated by the Brazilian Society of Cardiovascular Surgery Board of Directors. The members, divided into working groups, supplemented their contribution, corrections and recommendations accepted based on a consensus. The guideline is the original version of this consensus.
	Brazil		System developed and approved by ACC/AHA	

Clinical Practice Guidelines for Endovascular Abdominal Aortic Aneurysm Repair: Written by the Standards of Practice Committee for the Society of Interventional Radiology and Endorsed by the Cardiovascular and Interventional Radiological Society of Europe and the Canadian Interventional Radiology Association (2010)	Society of Interventional Radiology (SIR)	Interventional radiologists	Not outlined in guideline	<p>The Standards of Practice Committee members performed a literature search. Then, a critical review of retrieved articles was performed. The qualitative weight of these articles was assembled into an evidence table. When the evidence of literature was weak, conflicting, or contradictory, consensus for the parameter was reached using a Modified Delphi Consensus Method.</p> <p>The draft document was critically reviewed by the Standards of Practice Committee members and a finalized draft sent out to the SIR membership for further input/criticism during a 30-day comment period. These comments were discussed by the Committee, and appropriate revisions made to create the finished standards document. Prior to its publication the document was endorsed by the SIR Executive Council and collaborating organisations.</p>
	International		Not outlined in guideline	
ESC Guidelines on the diagnosis and treatment of aortic diseases (2014)	European society of Cardiology (ESC)	Vascular surgeons Radiologists	System developed and approved by ESC	<p>A task force of experts in the field was selected by the ESC Committee for Practice Guidelines (CPG). They undertook a literature search of the published evidence for the management of aortic diseases. Then, they performed a critical evaluation of the literature retrieved. The level of evidence and the strength of recommendation of management options were weighed and graded according to predefined scales. The</p>
	Europe	Cardiothoracic surgeons Cardiologists Geneticists	System developed and approved by ESC	

				resulting guidelines underwent extensive review by the CPG and external experts. After appropriate revisions, it was approved by all the experts involved in the Task Force. The finalized document was approved by the CPG for publication in the European Heart Journal.
The Society for Vascular Surgery practice guidelines on the care of patients with an abdominal aortic aneurysm (2017)	The Society for Vascular Surgery (SVS)	Vascular surgeons	GRADE system	A review of the available clinical evidence in the literature was conducted to generate a concise set of recommendations. The strength of any given recommendation and the quality of evidence were graded on the basis of the GRADE approach. Committees used consensus building and voting procedures to reach their final decisions on recommendations.
	USA		GRADE system	
European Society for Vascular Surgery (ESVS) Clinical Practice Guidelines on the Management of Abdominal Aorto-iliac Artery Aneurysms (2019)	European Society for Vascular Surgery (ESVS)	Vascular surgeons Academics	System developed and approved by ESC	The Guideline Writing Committee (GWC) were selected by the European Society for Vascular Surgery (ESVS). At a meeting in Hamburg in 2016 the tasks in creating the guideline were evaluated and distributed among the committee members. Members of the committee performed a systematic literature search. To define the current guidelines, members of the GWC reviewed and summarised the selected literature using the ESC grading system. Following preparation of the first draft, GWC members participated in a second meeting in Uppsala in 2017 to review the wording/
	Europe		System developed and approved by ESC	

				grading of each recommendation. If there was no unanimous agreement, discussions were held to decide how to reach a consensus. If this failed, then the wording, grade, and level of evidence was secured via a majority vote of the GWC members. The final version of the guideline was submitted in June 2018.
NICE guideline Abdominal aortic aneurysm: diagnosis and management (2020)	National Institute for Health and Care Excellence (NICE)	Vascular surgeons Interventional radiologists Interventional radiographers Nurses Emergency physicians Vascular scientists General practitioners Paramedics	GRADE system	Multiple reviews of the available clinical evidence in the literature were conducted by the guideline committee. Retrieved publications were critically appraised using the GRADE system and where possible incorporated into meta-analyses. Decisions on recommendations were reached through a process of informal consensus.
	UK		GRADE system	

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Abdominal aortic aneurysm clinical practice guidelines: a methodological assessment using the AGREE II instrument

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Abstract

Objectives: Abdominal aortic aneurysm (AAA) clinical practice guidelines (CPGs) provide evidence-based information on patient management; however, methodological differences exist in the development of CPGs. This study examines the methodological quality of AAA CPGs using a validated assessment tool.

Methods: Medline, EMBASE and online CPG databases were searched from 1946 to Oct 31, 2021. Full-text, English language, evidence-based AAA CPGs were included. Consensus-based CPGs, summaries of CPGs or CPGs which were only available upon purchase were excluded. Five reviewers assessed their quality using the Appraisal of Guidelines for Research and Evaluation II instrument. An overall guideline assessment scaled score of $\geq 80\%$ was considered as the threshold to recommend CPG use in clinical practice.

Results: Seven CPGs were identified. Scores showed good inter-reviewer reliability (ICC 0.943, 95% CI 0.915-0.964). On average, CPGs performed adequately with mean scaled scores of over 50% in all domains. However, between CPGs, significant methodological heterogeneity was observed in all domains. Four CPGs scored $\geq 80\%$ (European Society of Cardiology, the Society of Vascular Surgery, the European Society of Vascular Surgery, and the National Institute of Health and Care Excellence), supporting their use in clinical practice.

Conclusions: Four CPGs were considered of adequate methodological quality to recommend their use in clinical practice; nonetheless, these still showed areas for improvement, potentially through performing economic analysis and trial application of recommendations. A structured approach employing validated CPG creation tools should be used to improve rigour of AAA CPGs. Future work should also evaluate recommendation accuracy using validated appraisal tools.

Strengths and Limitations of this Study

- This study uses a widely used validated assessment tool to objectively assess the methodological quality of abdominal aortic aneurysm (AAA) clinical practice guidelines (CPGs).
- Good inter-reviewer reliability was maintained across the five assessors who independently assessed the AAA CPGs.
- A systematic approach was used to identify CPGs for inclusion in this review.
- However, limited number of CPGs were available for assessment.
- This study also does not comment on the accuracy of recommendations or the robustness of evidence behind them.

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57 **Introduction**

58 The management of the AAA patient is complex and involves members of the
59 multidisciplinary team, including, but not limited to, vascular scientists/technologists,
60 specialist nurses, emergency physicians, interventional radiologists, and vascular surgeons.
61 Multiple management pathways exist, with a spectrum of diagnostic and treatment options
62 available. Therefore, in view of this complexity and to aid clinicians in their management of
63 AAA, multiple clinical practice guidelines (CPGs) have been created by national and
64 international organisations. These are developed employing different methodologies, leading
65 to heterogeneity stemming from evidence grading, recommendation level, topics covered,
66 and the professionals who have been involved in their creation. Clinicians, while not legally
67 obligated to use CPGs, will often do so in their practice. Methodological rigour is therefore
68 required to provide accurate recommendations for the best care of AAA patients.

69
70 The quality of individual CPG methodology may be assessed using objective
71 instruments designed for such a purpose. One such instrument is the Appraisal of Guidelines
72 for Research and Evaluation II (AGREE II) tool¹. While other tools exist, the AGREE II
73 instrument has been the most extensively employed to assess CPG methodological quality
74 and has been applied in many other clinical areas, including orthopaedic surgery and other
75 subject matters in vascular surgery^{2,3}. In addition, the AGREE II instrument has the benefit of
76 acting as both a scoring system to evaluate CPG methodology as well as providing a
77 framework for CPG development. In depth assessment of the process of CPG guideline
78 development is performed using six domains: 1) Scope and Purpose, 2) Stakeholder
79 Involvement, 3) Rigour of Development, 4) Clarity of Presentation, 5) Applicability and 6)
80 Editorial Independence; importantly, it does not evaluate the scientific or clinical accuracy of
81 the recommendations.

82
83 This study aims to employ the AGREE II instrument to determine the methodological
84 quality of current AAA CPGs to fulfil two main objectives:

- 85 1) Identify AAA CPGs of high methodological quality that may be recommended for
86 use in clinical practice.

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3 87 2) Determine areas for improvement in future versions of current AAA CPGs or newly
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5 88 developed CPGs.
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4 89 **Materials and Methods**

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7 90 **Search Strategy**

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9 91 The Medline and EMBASE bibliographic databases were searched from 1946 to Oct
10 92 31, 2021 using the search algorithm outlined below:

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14 94 (((((practice guideline*) OR clinical practice guideline*) OR recommendation*))
15
16 95 AND
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18 96 (((management) OR diagnosis) OR assessment) OR treatment))
19
20 97 AND
21
22 98 (((((abdominal aorta) OR abdominal aortic aneurysm*) OR aortic aneurysm*) OR aorto-iliac
23 99 aneurysm*) OR AAA))

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25 100
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27 101 The Guidelines International Network and NHS Evidence Search databases were also
28
29 102 searched over the same period using the terms “aorta”, “aortic aneurysm” and “abdominal
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31 103 aortic aneurysm”.

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35 105 The reference lists of identified CPGs were hand searched to identify further relevant
36 106 guidelines. Two reviewers (M.T., S.S.) independently performed the article search and
37
38 107 reviewed the full CPGs to ensure fulfilment of all inclusion criteria. Any conflict between the
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40 108 two reviewers was discussed in person, and any unresolved disagreements were referred to
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42 109 a third reviewer (S.O.).

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46 111 **Inclusion and Exclusion Criteria**

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48 112 Full text, English language CPGs including evidence-based recommendations on AAA
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50 113 diagnosis and management were included. CPGs based only upon expert consensus, CPG
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52 114 summaries, or CPGs which were only available by purchase were excluded.

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AGREE II Assessment

Five reviewers (M.T., S.S., M.M., A.G., T.L.) independently assessed the included CPGs. All reviewers were selected based on their experience and extensive involvement in vascular surgery research. A range of clinical experience was also represented by the reviewers chosen, ranging from a newly qualified doctor to a trained consultant vascular surgeon. For each quality statement in the seven domains of the AGREE II instruments (domains and quality statements can be found in **Table 1**), CPGs were rated from 1 (lowest quality) to 7 (highest quality). The criteria for grading scores are provided in the AGREE II instrument for each statement to guide reviewers in their assessment but does not give specific points required for each numerical score⁴. Readers should note that the final domain entitled Overall Guideline Assessment contains two statements, the first of which (on overall quality) is rated from 1 to 7 while the second (on recommendation for use) is scored with a “Yes”, “Yes with modifications” or “No”.

Numerical domain scores were added and scaled using a predefined equation to determine the scaled quality score for each domain. The domain scaled quality score for each CPG was determined by taking the raw score total as a percentage of the maximum possible score for that domain using the following equation:
$$\frac{\text{Obtained score} - \text{Minimum possible score}}{\text{Maximum possible score} - \text{Minimum possible score}} \times 100$$
. All assessment and scaling of scores were performed according to the user manual available from the AGREE Research Trust website⁴.

A two-way mixed model was used to calculate intraclass correlation coefficients as a measure of inter-reviewer reliability. An overall guideline assessment scaled score of $\geq 80\%$

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140 was required to consider the guideline of adequate quality to recommend use in clinical
141 practice, as previously done in published studies using the AGREE II instrument^{5,6}. All
142 statistical analyses were performed using SPSS® Statistics V25 (IBM®, United States of
143 America).

145 Patient and Public Involvement

146 No patients were involved in this study.

Results

Selected Guidelines

Seven CPGs were identified from the literature search⁷⁻¹³ (**Figure 1**). CPGs were published between 2005 and 2020. Guideline development group members included general practitioners, nurses, emergency physicians, radiologists, cardiothoracic surgeons and vascular surgeons. The CPGs originated from the United States of America (n=3)⁷⁻⁹, with the remainder coming from Europe (n=3)¹⁰⁻¹² and Brazil (n=1)¹³. Further guideline characteristics are summarised in **Supplement 1**.

Quality Scores

Inter-reviewer reliability varied between domains, ranging from moderate (domains 1 and 6) to good (domains 2, 3, 4, 5, and overall quality) as determined using the intraclass correlation coefficients calculated. The overall intraclass correlation coefficient of all scores showed excellent reliability (ICC 0.943, 95% confidence interval 0.915 to 0.964) (**Table 2**).

Raw and scaled quality scores are summarised in **Table 3**.

Individual Domain Performance

Domain 1

Domain 1 focuses on the intended goals of the guideline, including statements that cover the scope of the CPGs or the health questions and target populations considered in the development of the CPGs.

AAA CPGs on average performed well in this domain (mean score 72.2±12.8%) with all CPGs scoring over 50% in the scaled scores. CPGs that performed better in this domain laid out clear review questions, specific objectives, and defined precisely the patient population that the CPG was intended for. For example, the European Society for Vascular Society CPG suggested that their CPG not only apply to patients with AAAs, but also to those with iliac artery aneurysms. Additionally, this CPG defined that the recommendations would include patients with “juxtarenal AAA, isolated iliac aneurysms, mycotic and inflammatory aneurysms

and concomitant malignant disease”¹¹. Poorer performing CPGs had either unclear objectives such as “critically reviewing the indications and the surgical results in the treatment of several aortic diseases”¹³ or failed to address any of the statements in their publication.

Domain 2

Domain 2 evaluates whether the CPG was developed by relevant stakeholders, which is essential for multidisciplinary input. It also considers the various aspects of healthcare provision offered by different healthcare professionals and the perspectives of the intended users of the CPG.

While CPGs performed adequately, there was greatest heterogeneity in scores for this domain (mean score 54.5±23.5%). This was largely due to the variability in team members that may be involved in the management of AAAs. For example, the Society of Interventional Radiology guideline scored poorly due to the sole involvement of radiologists in the CPG development process. While this CPG arguably was targeted at patients undergoing endovascular aneurysm repair, other medical professionals are involved in patients’ care pre- and post- endovascular aneurysm repair⁸. In this aspect, the National Institute of Health and Care Excellence CPG performed well, involving paramedics, general practitioners, vascular nurses, anaesthetists, radiologists, and vascular surgeons in their guideline committee¹². With reference to patient involvement in particular, the European Society for Vascular Society⁷ did especially well to involve AAA patients in focus groups and obtain feedback on a plain English summary of the recommendations.

Domain 3

Domain 3 contains eight statements which appraise the evidence-based rigour of the literature search methodology, evidence selection and evaluation, as well as the procedure followed in the formulation of recommendations, together with the processes in place to permit guideline updating.

CPGs had acceptable scores in this domain, averaging 65.2±18.4%. CPGs that performed poorly failed to describe the literature search methodology or the formulation of the methods involved in the development of their recommendations. The CPGs that

performed well provided detailed information regarding a systematic evidence search (e.g. databases, inclusion/exclusion criteria), recommendation formulation methodology (e.g. Delphi consensus), and the avenues for feedback prior to CPG publication. For example, the National Institute of Health and Care Excellence committee published a draft document which was freely available online, allowing any registered stakeholder to provide their comments on the draft recommendations¹². In addition to systematic reviews answering specific questions on the best modality and optimal frequency for surveillance after endovascular aneurysm repair, the Society for Vascular Surgery CPG also performed an “umbrella” systematic review to synthesise evidence from previous reviews. This CPG also clearly outlined the databases used in their evidence search and provided the full search strategy in their supplementary material.

Domain 4

Domain 4 evaluates the organisation of the guideline, discussing language and format. This domain includes statements assessing the ambiguity of included recommendations and the ease for CPG users to identify important recommendations.

CPGs performed very well in this domain (mean score $81.0 \pm 20.1\%$), with four CPGs achieving a scaled score of $>90\%$ ^{7,9-11}. These CPGs all provided clear summaries of their recommendations, highlighting important recommendations that should be implemented. Consistent formatting was used to draw readers’ attention to each recommendation, either with the recommendations placed in tables⁹⁻¹¹ or clear signposting of recommendations followed by the evidence related to them⁷. These CPGs also did well in placing their key recommendations in a summary section at the very start of the document^{9,12}. CPGs that performed poorly in this domain failed to highlight important recommendations, with recommendation statements embedded within the main text and making it difficult for readers to quickly identify recommendations^{8,13}.

Domain 5

Domain 5 assesses how guideline developers consider the translation of recommendations into clinical practice. These statements include the consideration of

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3 241 barriers and facilitators to implementation, uptake improvement strategies and resources
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5 242 required for implementation.
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9 244 CPGs fared worst in this domain, with the lowest average scores recorded (mean score
10 245 $47.1 \pm 21.2\%$). One method to identify potential resource limitations would be to implement a
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12 246 pilot implementation – this strategy, unfortunately, was not used by any CPG development
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14 247 group in this review. Alternatively, cost-benefit analysis could be very useful in estimating the
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16 248 economic impact of recommendation implementation. Cost-benefit analysis performed in
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18 249 other reviews were considered in the National Institute of Health and Care Excellence and
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20 250 Society for Vascular Surgery CPGs^{9,12}. Furthermore, these CPGs also provided potential
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22 251 research and audit questions to improve the current evidence base and service provision^{9,12}.
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24 252 The lack of pilot implementation programmes or cost-benefit analysis resulted in poorer
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26 253 scores in the Society of Interventional Radiology⁸ and European Society of Cardiology¹⁰ CPGs.
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29 255 **Domain 6**

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31 256 Domain 6 includes statements defining competing interests, both at the individual
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33 257 (declaration of individual CPG development group members' conflicts of interest) and
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35 258 institutional level (funding bodies' involvement).
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38 260 In this domain, CPGs performed adequately and achieved an average scaled score of
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40 261 $66.2 \pm 22.7\%$. CPGs that performed well provided unequivocal statements that described the
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42 262 conflicts of interest of CPG development group members^{7,12} and, if any, the involvement of
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44 263 funding agencies. One CPGs failed to include any statement of such a nature¹³, which is an
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46 264 easily corrected omission in future versions of this CPGs.
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49 266 **Overall Guideline Assessment**

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51 267 The Overall Guideline Assessment consists of two components: the overall quality
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53 268 rating of the CPG (rated from 1 to 7), and whether the reviewer would recommend use in
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55 269 clinical practice. Based on the predefined criteria of a scaled score of $>80\%$, four guidelines⁹⁻
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57 270 ¹² were rated of adequate methodological quality for use in clinical practice. These guidelines
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59 271 were from the European Society of Cardiology¹⁰, the Society of Vascular Surgery⁹, the
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272 European Society of Vascular Surgery¹¹, and the National Institute of Health and Care
273 Excellence¹².
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For peer review only

Discussion

This review has employed the AGREE II instrument in the assessment of the AAA CPGs, which is a widely used and validated methodological assessment tool that also acts as a framework for CPG development. The strength of the assessment was improved by the inclusion of five reviewers at various levels of academic and clinical training, and good inter-reviewer reliability was achieved. It must be noted that this assessment was limited by the small number of CPGs that were available in the literature, which is surprising given the clinical burden that AAAs represent.

AAA-related mortality is considerable, ranked as the 12th to 15th cause of death in the United States of America, United Kingdom and various European countries¹⁴. Mortality post-AAA rupture can exceed 80% and contributes to over 44.6 deaths per 100,000 population in the UK¹⁵. It is thus of utmost importance that CPGs detailing recommendations related to the diagnosis and management of this critical condition be of good quality, robust evidence base and easy access. Quality in CPGs stems from methodological rigour, and four CPGs included in this review were considered of adequate methodological quality for use in clinical practice. However, methodological rigour in each domain is independent and therefore, independent efforts are essential to correct the issues identified. This may be assisted by the multiple guideline development frameworks that exist, including the AGREE II instrument, G-I-N Standards¹⁶, or Guidelines 2.0¹⁷. To reduce heterogeneity and improved methodological rigour in CPGs, the international community should agree upon a specific framework for use in future CPG development.

While no clear characteristic significantly impacted on the AGREE II scores, a good domain 1 performance appeared to set a higher standard for other domain scores. This may be due to having clear methodology outlined prior to the beginning of the CPG development process – clear objectives, specific clinical questions, specific patient populations on whom to apply the recommendations – which may set a framework for meticulous methodology in other domains. NICE, for example, employs an established methodology that is constant across CPGs in various subject matters, and these methods are codified in a manual that is used by development groups during the development process¹⁸.

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307 It must be noted that in some CPGs a limited scope of individuals and specialties were
308 involved in the creation of the guidelines. For example, as discussed above in the results for
309 domain 2, the Society of Interventional Radiology CPG only included interventional
310 radiologists in their CPG development group; consequently, the document focused on specific
311 AAA management options (namely the various types of endovascular repair)⁸. This is reflected
312 in lower scores in domain 2 as well as the overall scores of the AGREE II instrument. Inclusion
313 of a more diverse panel in the CPG development group, on the other hand, resulted in broader
314 and more holistic approaches to how AAAs should be managed, as seen in the National
315 Institute of Health and Care Excellence¹² and European Society of Vascular Surgery¹¹ CPGs.

316

317 Domain 5 was the poorest performing domain in this assessment, with four CPGs
318 achieving a scaled score of <50%^{7,9,10,13}. This is not an isolated issue pertaining to AAA CPGs –
319 the lack of consideration of the resources required to apply CPG recommendations has been
320 seen in other vascular surgery topics including venous leg ulcers³ and lymphoedema¹⁹, and
321 other fields such as orthopaedics². Echoing the conclusions of these reviews, poor
322 performance in this domain is especially concerning as recommendations are futile if not
323 translated into clinical practice and applicable to the target populations. This is additionally
324 important in the management of AAA given the variable costs that arise depending on the
325 modality of treatment (i.e. open versus endovascular repair). A recent observational study
326 from the USA showed that while endovascular aneurysm repair was associated with lower
327 admission and fixed costs when compared to open repair, this was outweighed by increases
328 in variable hospitalisation costs associated with the procedure over time²⁰. It is clear therefore
329 that resource allocation must be considered in the formulation of CPG recommendations.
330 Recommendations should reflect the economic situation of the local population and not be
331 universal management ideals that may be unattainable in the specific country or region. It
332 would be ideal that development groups of future CPGs recognise this fact and perform local
333 cost-benefit analyses or pilot implementation of CPGs to identify specific economic barriers
334 unique to their healthcare system or population and adapt the CPG to overcome these issues.

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336 It is important to note that while this study does not intend to examine the accuracy
337 of the recommendations nor the robustness of the evidence behind them, it would

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338 nonetheless be remiss of the authors not to discuss issues with the current evidence. Most of
339 the recommendations are based on historic RCTs, including the UK EVAR-1²¹ and EVAR-2²²
340 amongst others²³⁻²⁵. Evidence-based recommendations will therefore be limited by old data
341 if trials were performed more than a decade ago. These trials need to be updated, especially
342 considering the constantly evolving technologies increasingly employed in vascular surgery
343 today, although recent registry data does seem to suggest that the findings of these trials
344 currently hold true²⁶⁻²⁸. CPGs, as an extension, should therefore also be constantly updated
345 as newer trials are published. Certain groups have proposed using an online electronic wiki
346 platform, allowing CPGs to become “living documents” that can be updated in sections²⁹ as
347 new trial data becomes available.

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349 The assessment of AAA guidelines via the AGREE II instrument has highlighted
350 methodological inadequacies. Development groups of future versions of these CPGs should
351 consider addressing these factors. Furthermore, while this review has provided a detailed
352 methodological assessment of currently available AAA CPGs, readers should note that has not
353 addressed the scientific accuracy of the recommendations.

354

355 Conclusion

356 In this methodological review of current AAA CPGs, four have been deemed adequate
357 for clinical use; nonetheless, all have been shown to have shortfalls in their methodology.
358 Future CPG iterations should consider that rigorous methodology can only be achieved
359 through conscious effort. However, high methodological quality in existing CPG versions may
360 not necessarily result in high quality future versions. A structured approach is integral to an
361 organised outcome; instruments to provide such a structure and thus boost methodological
362 rigour are widely available and should be implemented by developmental groups to improve
363 confidence in CPG rigour. This will, in turn, support the implementation of good evidence-
364 based recommendations to improve the care of AAA patients internationally.

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Contributors

M.T., S.O. and A.H.D. contributed to the conceptualisation of the review idea. M.T., S.S., M.M., A.G. and T.L. performed the methodological assessments of the guidelines. M.T. performed the statistical analysis and together with S.S. wrote the initial manuscript. S.O., T.L. and A.H.D. provided critical input into subsequent drafts of the manuscript. A.H.D. supervised the project. All authors provided critical feedback and contributed to the final version of the manuscript.

Competing interests

All authors report no relevant conflicts of interests.

Ethical Approval

No ethical approval was required for this study as there was no involvement of patients or animals.

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Data Availability Statement

No additional data are available.

Figures

Figure 1: Guideline selection flowchart

Tables

Table 1: AGREE II instrument domains and statements

Domain	Statements
1 – Scope and Purpose	<ul style="list-style-type: none">• The overall objective(s) of the guideline is (are) specifically described.• The health question(s) covered by the guideline is (are) specifically described.• The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.
2 – Stakeholder Involvement	<ul style="list-style-type: none">• The guideline development group includes individuals from all relevant professional groups.• The views and preferences of the target population (patients, public, etc.) have been sought.• The target users of the guideline are clearly defined.
3 – Rigour of Development	<ul style="list-style-type: none">• Systematic methods were used to search for evidence.• The criteria for selecting the evidence are clearly described.• The strengths and limitations of the body of evidence are clearly described.• The methods for formulating the recommendations are clearly described.• The health benefits, side effects, and risks have been considered in formulating the recommendations.• There is an explicit link between the recommendations and the supporting evidence.• The guideline has been externally reviewed by experts prior to its publication.• A procedure for updating the guideline is provided.
4 – Clarity of Presentation	<ul style="list-style-type: none">• The recommendations are specific and unambiguous.• The different options for management of the condition or health issue are clearly presented.• Key recommendations are easily identifiable.
5 – Applicability	<ul style="list-style-type: none">• The guideline describes facilitators and barriers to its application.• The guideline provides advice and/or tools on how the recommendations can be put into practice.• The potential resource implications of applying the recommendations have been considered.• The guideline presents monitoring and/or auditing criteria.
6 – Editorial Independence	<ul style="list-style-type: none">• The views of the funding body have not influenced the content of the guideline.• Competing interests of guideline development group members have been recorded and addressed.
Overall Guideline Assessment	<ul style="list-style-type: none">• Rate the overall quality of this guideline.• I would recommend this guideline for use. (Yes, Yes with modifications, No)

Table 2: Intraclass correlation coefficient of scores given to the individual domains

Domain	Intraclass Correlation	95% Confidence Interval		Inter-reviewer Reliability
		Lower Bound	Upper Bound	
1	0.679	0.364	0.921	Moderate
2	0.891	0.722	0.977	Good
3	0.797	0.541	0.954	Good
4	0.753	0.469	0.943	Good

5	0.875	0.688	0.973	Good
6	0.709	0.405	0.930	Moderate
Overall Guideline Assessment	0.841	0.620	0.965	Good
All Domains	0.943	0.915	0.964	Excellent

Table 3: Individual reviewer, raw total, and scaled scores for individual domains. Cells with scaled scores $\leq 25\%$, 26-50%, 51-75%, and $\geq 76\%$ are coloured with red, orange, yellow, and green respectively. Bolded scaled scores reflect the lowest and highest scores in each domain.

	Domain (min. score, max. score)						
Guideline	1 (min. 3, max. 21)	2 (min. 3, max. 21)	3 (min. 8, max. 56)	4 (min. 3, max. 21)	5 (min. 4, max. 28)	6 (min. 2, max. 14)	Overall Guideline Assessment (min. 1, max. 7)
American College of Cardiology/American Heart Association ⁷							
Reviewer 1	14	11	40	18	12	11	5
Reviewer 2	18	14	41	20	19	11	6
Reviewer 3	17	13	46	20	20	11	6
Reviewer 4	15	13	44	20	16	13	6
Reviewer 5	15	8	49	21	10	12	5
Raw total	79	59	220	99	77	58	28
Scaled (%)	71.1	48.9	75.0	93.3	47.5	80.0	76.7
Brazilian Society of Cardiovascular Surgery ¹³							
Reviewer 1	11	8	20	13	5	2	3
Reviewer 2	14	9	34	20	9	2	4
Reviewer 3	14	10	30	18	9	2	4
Reviewer 4	12	7	16	12	4	5	2
Reviewer 5	14	8	16	12	4	11	4
Raw total	65	42	116	75	31	22	17
Scaled (%)	55.5	30.0	31.7	66.7	9.2	20.0	40.0
Society of Interventional Radiology ⁸							
Reviewer 1	10	6	32	8	10	7	4
Reviewer 2	18	11	40	12	13	9	5
Reviewer 3	15	10	42	14	15	8	5
Reviewer 4	12	8	22	9	11	11	4
Reviewer 5	13	6	22	9	11	9	3
Raw total	68	41	158	52	60	44	21
Scaled (%)	58.9	28.9	49.2	41.1	33.3	56.7	53.3
European Society of Cardiology ¹⁰							
Reviewer 1	15	10	40	17	15	12	6
Reviewer 2	21	15	43	21	22	12	6
Reviewer 3	19	14	46	19	22	12	6
Reviewer 4	12	9	34	21	9	12	5
Reviewer 5	15	10	34	21	9	12	6
Raw total	82	58	197	99	77	60	29
Scaled (%)	74.4	47.8	65.4	93.3	47.5	83.3	80.0
Society for Vascular Surgery ⁹							
Reviewer 1	14	10	39	17	21	9	6
Reviewer 2	19	16	49	19	23	12	7
Reviewer 3	17	14	48	21	21	11	6

Reviewer 4	15	16	45	21	16	10	6
Reviewer 5	17	12	45	21	16	11	5
Raw total	82	68	226	99	97	53	30
Scaled (%)	74.4	58.9	77.5	93.3	64.2	71.7	83.3
European Society of Vascular Surgery ¹¹							
Reviewer 1	13	13	37	16	15	8	6
Reviewer 2	18	19	48	19	23	11	7
Reviewer 3	18	18	50	21	21	11	6
Reviewer 4	17	15	42	21	13	10	6
Reviewer 5	18	14	42	21	13	10	6
Raw total	84	79	219	98	85	50	31
Scaled (%)	76.7	71.1	74.6	92.2	54.2	66.7	86.7
National Institute of Clinical Excellence ¹²							
Reviewer 1	18	18	44	19	21	12	7
Reviewer 2	19	20	50	17	25	13	7
Reviewer 3	21	21	51	17	27	13	7
Reviewer 4	21	21	47	20	18	11	7
Reviewer 5	21	21	47	20	18	12	7
Raw total	100	101	239	93	109	61	35
Scaled (%)	94.4	95.6	82.9	86.7	74.2	85.0	100.0
Average scaled scores							
Mean ± SD (%)	72.2 ± 12.8	54.4 ± 23.5	65.2 ± 18.4	81.0 ± 20.1	47.1 ± 21.2	66.2 ± 22.7	74.3 ± 20.6

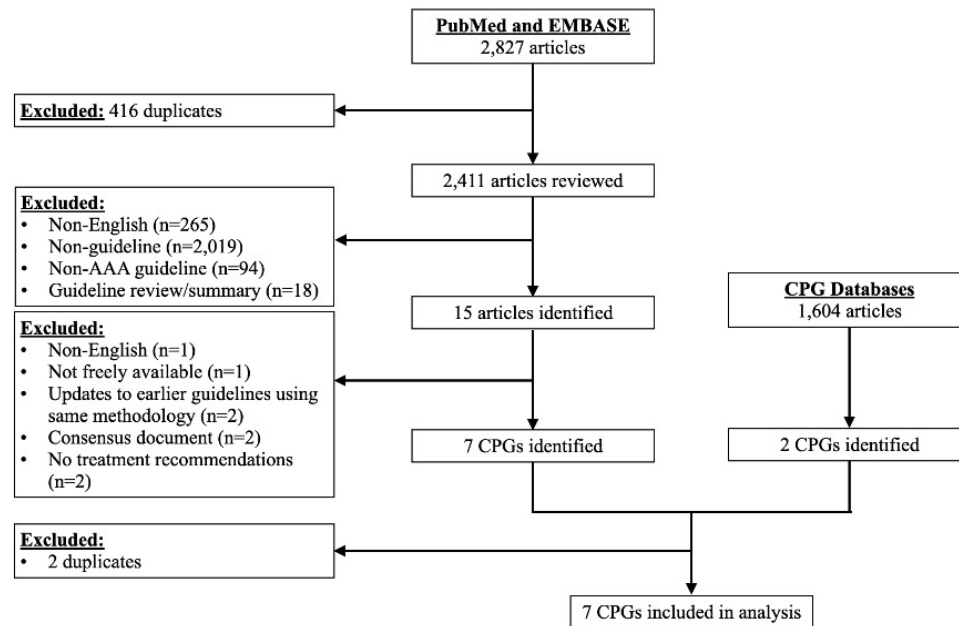


Figure 1: Guideline selection flowchart

159x104mm (144 x 144 DPI)

Supplement 1: Guideline characteristics

Guideline (Year)	Author/Organisation	Healthcare Professionals Involved in Guideline Development	Evidence Grading System	Summary of Guideline Creation Procedure
	Country/Region		Recommendation Grading System	
ACC/AHA Practice Guidelines for the Management of Patients With Peripheral Arterial Disease (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic) (2005)	American College of Cardiology (ACC) /American Heart Association (AHA)	Vascular surgeons Interventional radiologists Vascular physicians Cardiologists Nurses	System developed and approved by ACC/AHA	The Committee to Develop Guidelines for Peripheral Arterial Disease conducted a literature search. Using evidence-based methodologies developed by the ACC/AHA Task Force on Practice Guidelines, the committee wrote the guideline text and recommendations. All guideline recommendations were formally voted on via a confidential ballot. The guidelines were then peer-reviewed and approved for publication by the governing bodies of the American College of Cardiology (ACC) and the AHA and endorsed by collaborating organizations.
	USA		System developed and approved by ACC/AHA	
Guidelines for Surgery of Aortic Diseases from Brazilian Society of Cardiovascular Surgery (2007)	Brazilian Society of Cardiovascular Surgery	Cardiovascular surgeons Cardiothoracic surgeons	System developed and approved by ACC/AHA	The authors met periodically to elaborate the text and review the relevant bibliographic citations provided by the official committee members designated by the Brazilian Society of Cardiovascular Surgery Board of Directors. The members, divided into working groups, supplemented their contribution, corrections and recommendations accepted based on a consensus. The guideline is the original version of this consensus.
	Brazil		System developed and approved by ACC/AHA	
Clinical Practice Guidelines for Endovascular Abdominal Aortic	Society of Interventional Radiology (SIR)	Interventional radiologists	Not outlined in guideline	The Standards of Practice Committee members performed a literature

<p>Aneurysm Repair: Written by the Standards of Practice Committee for the Society of Interventional Radiology and Endorsed by the Cardiovascular and Interventional Radiological Society of Europe and the Canadian Interventional Radiology Association (2010)</p>	<p>International</p>		<p>Not outlined in guideline</p>	<p>search. Then, a critical review of retrieved articles was performed. The qualitative weight of these articles was assembled into an evidence table. When the evidence of literature was weak, conflicting, or contradictory, consensus for the parameter was reached using a Modified Delphi Consensus Method. The draft document was critically reviewed by the Standards of Practice Committee members and a finalized draft sent out to the SIR membership for further input/criticism during a 30-day comment period. These comments were discussed by the Committee, and appropriate revisions made to create the finished standards document. Prior to its publication the document was endorsed by the SIR Executive Council and collaborating organisations.</p>
<p>ESC Guidelines on the diagnosis and treatment of aortic diseases (2014)</p>	<p>European society of Cardiology (ESC)</p>	<p>Vascular surgeons Radiologists Cardiothoracic surgeons Cardiologists Geneticists</p>	<p>System developed and approved by ESC</p>	<p>A task force of experts in the field was selected by the ESC Committee for Practice Guidelines (CPG). They undertook a literature search of the published evidence for the management of aortic diseases. Then, they performed a critical evaluation of the literature retrieved. The level of evidence and the strength of recommendation of management options were weighed and graded according to predefined scales. The resulting guidelines underwent extensive review by the CPG and</p>
	<p>Europe</p>		<p>System developed and approved by ESC</p>	

				external experts. After appropriate revisions, it was approved by all the experts involved in the Task Force. The finalized document was approved by the CPG for publication in the European Heart Journal.
The Society for Vascular Surgery practice guidelines on the care of patients with an abdominal aortic aneurysm (2017)	The Society for Vascular Surgery (SVS)	Vascular surgeons	GRADE system	A review of the available clinical evidence in the literature was conducted to generate a concise set of recommendations. The strength of any given recommendation and the quality of evidence were graded on the basis of the GRADE approach. Committees used consensus building and voting procedures to reach their final decisions on recommendations.
	USA		GRADE system	
European Society for Vascular Surgery (ESVS) Clinical Practice Guidelines on the Management of Abdominal Aorto-iliac Artery Aneurysms (2019)	European Society for Vascular Surgery (ESVS)	Vascular surgeons Academics	System developed and approved by ESC	The Guideline Writing Committee (GWC) were selected by the European Society for Vascular Surgery (ESVS). At a meeting in Hamburg in 2016 the tasks in creating the guideline were evaluated and distributed among the committee members. Members of the committee performed a systematic literature search. To define the current guidelines, members of the GWC reviewed and summarised the selected literature using the ESC grading system. Following preparation of the first draft, GWC members participated in a second meeting in Uppsala in 2017 to review the wording/grading of each recommendation. If there was no unanimous agreement,
	Europe		System developed and approved by ESC	

				discussions were held to decide how to reach a consensus. If this failed, then the wording, grade, and level of evidence was secured via a majority vote of the GWC members. The final version of the guideline was submitted in June 2018.
NICE guideline Abdominal aortic aneurysm: diagnosis and management (2020)	National Institute for Health and Care Excellence (NICE)	Vascular surgeons Interventional radiologists Interventional radiographers Nurses Emergency physicians Vascular scientists General practitioners Paramedics	GRADE system	Multiple reviews of the available clinical evidence in the literature were conducted by the guideline committee. Retrieved publications were critically appraised using the GRADE system and where possible incorporated into meta-analyses. Decisions on recommendations were reached through a process of informal consensus.
	UK		GRADE system	



PRISMA 2020 Checklist

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Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	NA
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	NA
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 5
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 5-6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 5-6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	NA
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	NA
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	NA
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	NA
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	NA
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	NA
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	NA
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	NA
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	NA
Certainty	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA

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PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
assessment			
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 5, Page 20
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 20
Study characteristics	17	Cite each included study and present its characteristics.	Pages 8-11
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	NA
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	NA
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	NA
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	NA
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	NA
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NA
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pages 12-14
	23b	Discuss any limitations of the evidence included in the review.	Page 12-13
	23c	Discuss any limitations of the review processes used.	Pages 13-14
	23d	Discuss implications of the results for practice, policy, and future research.	Pages 12-14
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	NA
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	NA
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	NA
Competing interests	26	Declare any competing interests of review authors.	NA
Availability of data, code and	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review	NA



PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
other materials			

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

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